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Weather

TROPICAL CYCLONE RECONNAISSANCE

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This instruction implements AFD 15-1, *Atmospheric and Space Environmental Support*, and HQ PACAF responsibilities under USCINCPACINST 3140.1x (latest version), Tropical Cyclone Operations Manual. It prescribes procedures and responsibilities applicable to all USAF units in the USPACOM area to establish, operate, and maintain the Tropical Cyclone Reconnaissance Network and provide data to supplement tropical cyclone reconnaissance. See [Attachment 1](#) for glossary of references, abbreviations, and acronyms. This publication does not apply to the Air National Guard or Air Force Reserve units and members.

SUMMARY OF REVISIONS

This document is substantially revised and must be completely reviewed.

A “[” indicates revised material since the last edition.

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Section A—General

1. Background. The 17 OWS/WXJ, Satellite Operations, performs tropical cyclone reconnaissance using data from satellite, radar, and other conventional sources to execute PACAF's Executive Agency Responsibility for Tropical Cyclone Reconnaissance. To ensure maximum exploitation of all USAF owned data sources across the AOR, HQ PACAF established the Tropical Cyclone Reconnaissance Network (TCRN) providing a construct for effective management, coordination, and maintenance of systems and procedures supporting typhoon reconnaissance.

2. Area of Responsibility. Each year, tropical cyclones threaten US forces operating in the Pacific and Indian oceans. The Joint Typhoon Warning Center (JTWC), Pearl Harbor; the Central Pacific Hurricane Center (CPHC), Honolulu; and the National Hurricane Center (NHC), Miami issues tropical cyclone warnings and advisories. JTWC's area of responsibility (AOR) is from the East Coast of Africa to the West Coast of the Americas. If for any reason the JTWC is unable to support its AOR, responsibility shifts to the Alternate Joint Typhoon Warning Center (AJTWC) located at Fleet Numerical Meteorology and Oceanography Center, Monterey, CA. CPHC issues civil tropical cyclone forecasts/advisories north of the equator between 180° and 140° W. NHC issues civil tropical cyclone forecasts/advisories north of the equator between 140° W and the West Coast of the Americas. In the CPHC and NHC AORs JTWC issues military tropical cyclone warnings tailored from the civil agencies' forecasts/advisories.

Section B—Satellite Support

3. Pacific Tropical Cyclone Reconnaissance Network. (TCRN). The following units owning and operating a MARK IVB and/or providing tropical cyclone (TC) satellite based fixes comprise the TCRN; contact information is in [Attachment 2](#). Personnel assigned to 17 OWS/WXJ Satellite Operations (SATOPS) retain the sole tropical cyclone reconnaissance mission in PACAF. SATOPS personnel include a METSAT Coordinator (MSC), the SATOPS NCOIC, and a team of enlisted forecaster/analysts. SATOPS uses tropical cyclone position and intensity information derived from, or provided by, TCRN sites to execute the PACAF Executive Agency Responsibility for Tropical Cyclone Reconnaissance supporting JTWC tropical cyclone forecast operations.

| <u>SITE LOCATION</u> | <u>ICAO</u> | <u>OPR</u> |
|-----------------------------|--------------------|------------------------------|
| Pearl Harbor, Hawaii | PGTW | 17 OWS/WXJ |
| Yokota AB, Japan | RJTY | 20 OWS |
| Kadena AB, Japan | RODN | 18 OSS/OSW |
| Hickam AFB, Hawaii | PHIK | 17 OWS |
| Offutt AFB, Nebraska | KGWC | AFWA/XOGM |
| Diego Garcia | FJDG | NAVCENTMETOCDET DIEGO GARCIA |
| Andersen AFB, Guam | PGUA | 36 OSS/OSW |
| Elmendorf AFB | PAED | 11 OWS |

3.1. The primary component of the TCRN is the MARK IVB (AN/UMQ-13 (V)) network. The SATOPS uses the MARK IVB client-server capability to access the Kadena AB, Andersen AFB, Elmendorf AFB and Hickam AFB MARK IVB data to perform tropical cyclone reconnaissance. The SATOPS client workstation uses the Hickam MARK IVB as a primary server. MARK IVB servers employ peer-to-peer access control, limiting access to local clients, remote clients, and other MARK IVB servers. Peer-to-peer access is common user communications based, i.e. base LAN and NIPR-NET, not dedicated circuits.

3.2. MARK IVB technicians assigned to Communications Squadrons at Kadena AB, Andersen AFB, Elmendorf AFB and Hickam AFB maintain the MARK IVBs. Successful exploitation of the TCRN MARK IVB sites requires close coordination between SATOPS, local MARK IVB Administrators, and MARK IVB technicians. The local MARK IVB Administrator will coordinate with the MARK IVB technicians to meet the requirements of the TCRN Coordinator. Conversely, coordination from the MARK IVB Technicians to the TCRN Coordinator must be through the local MARK IVB Administrator.

3.3. TCRN Operation and Management

3.3.1. 17 OWS/WXJ Satellite Analyst will:

3.3.1.1. Conduct 24-hour meteorological watch on all tropical and subtropical disturbances within the JTWC AOR. Report positions, estimated intensities and warning criteria wind radii of significant tropical cyclones in these regions using the format provided in [Attachment 6](#).

3.3.1.2. Establish written procedures for conducting quality control (QC).

3.3.1.3. Conduct on-the-spot QC of any tropical cyclone position reports received from sources outside JTWC.

3.3.1.4. Conduct “after-the-fact” product QC of locally produced tropical cyclone position reports.

3.3.1.5. Make and disseminate tropical cyclone observations based on all available data: geostationary, low earth orbiting (LEO) satellite imagery and WSR-88D. Provide positions every 3 hours and intensities every 6 hours or more frequently as requested by the Typhoon Duty Officer (TDO).

3.3.2. 17 OWS/WXJ Meteorological Satellite Coordinator (MSC) will:

3.3.2.1. Function as TCRN Coordinator and manage daily operations and tasking of TCRN sites for tropical cyclone reconnaissance support within the JTWC AOR.

3.3.2.2. Function as the liaison to AFWA/XOGM on all operational satellite assignments, taskings and products. Users from other MAJCOMs should staff their request through AFWA/XOGM who will, in turn, coordinate with 17 OWS/WXJ. The MSC will support requests for missions in other MAJCOMs after considering and balancing the assets available for tropical cyclone reconnaissance. NOTE: Users should coordinate directly through AFWA/XO (help-desk) on communication outages and equipment problems.

3.3.2.3. Communicate directly with weather flights and maintenance personnel at all TCRN sites to execute para 3.1.2.1.

3.3.2.4. Provide an end-of-year storm summary of TCRN tropical cyclone position and inten-

sity estimate accuracy relative to the JTWC final “best-tracks.” This summary is contained within the Annual Tropical Cyclone Report (ATCR) and briefed at the annual Tropical Cyclone and MARK IVB Administrator’s Conferences.

3.3.2.5. Inform the Director, JTWC of changes in the overall status of the TCRN.

3.3.2.6. Coordinate with the Deputy Director, JTWC, for transfer of TCRN control to AFWA/XOGM and notify TCRN MARK IVB Administrators of the change by the most expeditious means available.

3.3.2.7. Notify all TCRN members when 17 OWS/WXJ resumes control of the TCRN from AFWA/XOGM.

3.3.2.8. When applicable, request AFWA report tropical cyclone position and intensity estimates.

3.3.3. Each PACAF unit in [Attachment 2](#) will:

3.3.3.1. If operating a MARK IVB, appoint a MARK IVB Administrator.

3.3.3.2. Record tropical cyclone satellite-derived position and intensity estimates on PACAF Form 413, using the guidance in [Attachment 3](#), prior to transmission via long-line dissemination. Long-line dissemination format is provided in [Attachment 6](#).

3.4. TCRN backup procedures.

3.4.1. In the event that 17 OWS/WXJ cannot maintain responsibility as TCRN Coordinator due to communications outage, equipment problems, etc., the 17 OWS/WXJ MSC will coordinate transfer of TCRN control to AFWA/XOGM. The AFWA/XOGM MSC will then assume responsibility for providing satellite imagery, imagery analysis, METWATCH, positioning, and intensity estimates of tropical and subtropical cyclones, and all other normal operations supporting either the AJTWC or JTWC.

3.4.2. The AFWA/XOGM MSC serves as an interface between the JTWC, or the activated AJTWC, and TCRN units providing satellite reports on tropical cyclones.

3.4.3. AFWA/XOGM will:

3.4.3.1. Arrange for, and provide, satellite support to either the AJTWC or JTWC.

3.4.3.2. Direct the operation of the TCRN after assumption of TCRN responsibilities from 17 OWS/WXJ.

3.4.3.3. After assumption and acknowledgement of TCRN control responsibility from 17 OWS/WXJ, inform the TCRN MSCs.

3.4.3.4. Determine the availability of satellite resources with respect to the JTWC or AJTWC warning requirements, to include pass coverage, time, and spacecraft.

3.4.3.5. Coordinate satellite tasking with the JTWC or AJTWC Typhoon Duty Officer (TDO).

3.4.3.6. Upon return of TCRN control to 17 OWS/WXJ, inform 17 OWS/WXJ of current tasking and overall site status.

3.4.3.7. Provide tropical cyclone positions and intensity outside the GOES-9/MTSAT footprint IAW the latest Satellite Reconnaissance Program Support Assistance Request (SAR).

3.4.3.8. Coordinate with CPHC as outlined in the National Hurricane Operations Plan (latest version).

3.4.3.9. Participates in all AJTWC exercises.

3.4.3.10. AFWA/XOGM trains a sufficient number of assigned forecasters to support the JTWC or AJTWC operations.

3.5. TCRN Training .

3.5.1. 17 OWS/WXJ and AFWA/XOGM should co-host a bi-annual MARK IVB Administrator's conference to facilitate cooperation between 17 OWS/WXJ and TCRN locations. The workshop will be an open forum to discuss new techniques, review standardized procedures, and develop close working relationship between AFWA, the TCRN, and the civilian research community and also to familiarize MARK IVB users with JTWC's & AFWA's METSAT requirements and uses of each data type.

3.5.2. The AFWA/XOGM MSC and Meteorological Satellite Specialist (MSS) receive training at 17 OWS/WXJ upon assignment of MSC/MSS duties. TCRN orientation training should be scheduled during the early part of the storm season. Annual MARK IVB Administrator refresher training should be completed just prior to the annually scheduled AJTWC activation.

3.6. **TCRN MARK IVB Geostationary and Low Earth Orbit Satellite Assignment** . Each TCRN MARK IVB will be assigned a specific geostationary satellite. This ensures SATOPS has access to near real-time geostationary satellite data across the entire AOR. Here again, AFWA/XOGM, the TCRN Coordinator, MARK IVB Administrators, and MARK IVB maintenance technicians must work closely to ensure success.

3.6.1. SATOPS will coordinate MARK IVB system status daily with each MARK IVB site via teleconference.

3.6.2. SATOPS will transmit long-line a daily NOPA44 PGTW bulletin indicating the MARK IVB status at each TCRN site.

3.6.3. The OPR for the MARK IVB TC Reconnaissance Network is the Tropical Cyclone Reconnaissance Network (TCRN) Coordinator at JTWC. The TCRN Coordinator ensures the local MARK IVB Administrators have adequate guidance to fulfill their geostationary antenna assignments.

3.6.4. The MARK IVB Administrator at each site (Kadena AB, Andersen AFB, Elmendorf AFB and Hickam AFB) will dedicate their local geostationary antenna to their assigned geostationary satellite, unless directed to change by the TCRN Coordinator.

3.6.5. Hickam, Elmendorf, Andersen and Kadena Communication MARK IVB technicians are responsible for maintaining and moving the MARK IVB antenna only when requested to do so by the local MARK IVB Administrator.

3.6.6. Any maintenance to a local MARK IVB requiring a movement of the geostationary antenna or a change in geostationary assignment for the antenna(s) must be coordinated with the local MARK IVB Administrator who, in turn, coordinates with the TCRN Coordinator.

3.6.7. TCRN MARK IVB Satellite Assignments Responsibilities.

3.6.7.1. Assignment changes will be coordinated between AFWA/XOGM, the TCRN Coordi-

nator and the local MARK IVB Administrator.

3.6.7.2. TCRN MARK IVBs have the following geostationary satellite assignments for their primary MARK IVB geostationary antenna, but may differ from this configuration based on mission needs and approval of the TCRN Coordinator:

| Base | Geostationary Satellite Assignment + | Alternate Satellite Assignment + |
|---------------|--------------------------------------|----------------------------------|
| Hickam AFB | GOES-9/MTSAT++ | GOES-10 |
| Elmendorf AFB | GOES-10 | N/A |
| Andersen AFB | FY-2B+ | GOES-9/MTSAT++ |
| Kadena AB | MET-5 | GOES-9/MTSAT++ |

+ (Based on availability)

++ The Japanese MTSAT is scheduled for launch in early 2004 with operations by mid 2004 (as of June 2003)

3.6.7.3. Alternate Solutions to Mission Conflict.

3.6.7.3.1. The MARK IVB geostationary antenna may be programmed to alternate between the assigned primary and alternate satellite. The Communication Squadron's MARK IVB technicians are solely responsible for programming the geostationary antenna. This procedure must be coordinated with the TCRN Coordinator and the local MARK IVB Administrator prior to programming. Careful consideration must be given to the additional wear-and-tear on equipment caused by constant switching between geostationary satellites. Dual-geostationary ingest on a single antenna causes significant shortening of the antenna's life.

3.6.7.3.2. The MARK IVB tracking antenna may be used to allow dual geostationary ingest. The Communication Squadron's MARK IVB technicians are solely responsible for programming the tracking antenna. This procedure must be coordinated with the TCRN Coordinator and the local MARK IVB Administrator prior to programming.

3.6.8. Low Earth Orbit (LEO). LEO pass priorities are as follows: all DMSP then NOAA passes between 1 hour before and 30 minutes after the warning time (in the warning window). Under special circumstances, the 17 OWS/WXJ may temporarily modify this priority.

3.7. TCRN MARK IVB Outages . Reliable access to the TCRN MARK IVB network is critical to the success of tropical cyclone reconnaissance in PACAF. AFWA/XOGM, the PACAF TCRN Coordinator, MARK IVB Administrators, and MARK IVB maintenance technicians must work closely and maintain constant coordination to ensure this reliability.

3.7.1. Scheduled Outages.

3.7.1.1. The local MARK IVB Administrator at each TCRN site will:

3.7.1.1.1. Establish procedures with the local Base Network Control Center to ensure immediate notification of scheduled base network outages expected to impact external or internal access to their local MARK IVB server.

3.7.1.1.2. Establish procedures with the local MARK IVB maintenance technicians to

ensure immediate notification of scheduled maintenance expected to impact external or internal access to their local MARK IVB server or the reception and processing of satellite data.

3.7.1.1.3. Immediately notify the TCRN Coordinator, by telephone, of any scheduled network service outage or scheduled maintenance affecting access to their local MARK IVB.

3.7.1.2. The TCRN Coordinator will:

3.7.1.2.1. Weigh the impact of scheduled outages and make every possible effort to accommodate the requirements of each MARK IVB site.

3.7.1.2.2. Must coordinate with the local MARK IVB Administrator during any MARK IVB outage to determine an estimated system down time and relate the impact of the outage for the purpose of aiding the Administrator in bringing the MARK IVB back into service.

3.7.1.3. The local MARK IVB maintenance technicians will:

3.7.1.3.1. Notify the local MARK IVB Administrator of any scheduled maintenance impacting internal or external access to the local server.

3.7.1.3.2. Notify the local MARK IVB Administrator of any scheduled maintenance impacting the reception and processing of satellite data.

3.7.2. Unscheduled TCRN Service Outages.

3.7.2.1. A local MARK IVB outage may be reported to the base Job Control Center only through the local MARK IVB Administrator either by their own request or upon request of the TCRN Coordinator. Job Control Numbers (JCN) opened solely by a MARK IVB Administrator must be immediately reported to the TCRN Coordinator.

3.7.2.2. The MARK IVB Administrator may not close any MARK IVB specific JCN without the approval of the TCRN Coordinator. Only a MARK IVB Administrator may communicate the closing of a JCN with their local Job Control.

3.7.2.3. Job Control will provide updates to the local MARK IVB Administrator upon request.

3.7.2.4. Each team of MARK IVB technicians (2E1XX) is responsible for maintaining their systems to include: repair actions, system administration, coordination on connectivity issues, and coordination with other work centers when necessary.

3.7.2.5. Each MARK IVB technician will notify the local MARK IVB Administrator of changes in system status, equipment status, and/or client access.

Section C—Radar Support and Data Collection

4. Radar Reconnaissance. This section describes the role of USAF units in the Pacific Radar Tropical Cyclone Reporting System. The purpose of the reporting system is to ensure that timely, high quality radar observations are made available to appropriate warning agencies (JTWC or CPHC). The storm fix is used to accurately initialize storm location, thus ensuring the most accurate forecast track. [Attachment 7](#) lists specific WSR-88D settings for TC reporting.

- 4.1. Operational Weather Squadrons listed in [Attachment 4](#) possessing an OPUP connection to WSR-88D radars in their AOR will:
- 4.2. Take special radar observations as required by USCINCPACINST 3140.1x (or latest version). Provide tropical cyclone position reports to JTWC, using the format prescribed in [Attachment 5](#), whenever a tropical cyclone is within range or detected regardless of warning or condition of readiness status.
- 4.3. If the capability exists, make the following minimum products available via the OWS web page accessible through the NIPRNET (Unclassified but Sensitive Internet Protocol Router Network).
 - 4.3.1. Base Reflectivity; .5 degree, 124nm range, .54 nm resolution.
 - 4.3.2. Base Reflectivity; 1.5 degree, 124 nm range, .54 nm resolution.
 - 4.3.3. Base Velocity; .5 degree, 124nm range, .54 nm resolution.
 - 4.3.4. Base Velocity; 1.5 degree, 124 nm range, .54 nm resolution.
 - 4.3.5. Ensure an appropriate number of personnel are knowledgeable of, and comply with, standard procedures for reporting tropical cyclones.
- 4.4. The unit radar manager will ensure the JTWC (or designated backup) PUP/OPUP has priority to a real-time WSR-88D dial-up port.
- 4.5. If the capability exists, Archive II (or OPUP product database archive) will be maintained for all TCs passing within range.
- 4.6. 20th OWS will make Tactical Weather Radar (TWR) data available from Yokota AB to provide post-storm analysis as requested by JTWC.
- 4.7. Until OPUPs at OWSs reach Full Operational Capability, Combat Weather Teams listed in [Attachment 4](#), possessing a PUP connection to the NEXRAD, are responsible for taking the special radar observations as directed above.

5. Tropical Cyclone Message.

- 5.1. IAW USCINCPACINST 3140.1x (latest version), when a TC of tropical storm strength or greater passes within 150nm of a USAF military weather reporting unit in PACOM, that unit will prepare a message and send it to JTWC within 24 hours of passage. The message will include the following:
 - 5.1.1. Name of tropical cyclone.
 - 5.1.2. Date and time of occurrence.
 - 5.1.3. Closest point of approach (azimuth and range of storm center). CWTs may need to obtain this information from their respective OWS, once OPUP is fully operational.
 - 5.1.4. Maximum sustained wind.
 - 5.1.5. Peak gust.
 - 5.1.6. Minimum sea level pressure.
- 5.2. Using USCINCPACINST 3140.1x (latest version) as guidance, mail the following information to the Commander, U.S. Naval Pacific Meteorology and Oceanographic Center/JTWC.

5.2.1. Photographs of storm action or damage.

5.2.2. Radar photographs or captured images. While WSR-88Ds are still in use, CWTs must coordinate with their respective OWS, prior to storm arrival, to ensure adequate archive is maintained for post-storm assessment. Once the OWSs have declared their OPUP fully operational, the OWS assumes full responsibility for providing radar data to JTWC.

5.2.3. Clippings from local newspapers concerning the storm.

5.2.4. In case of sufficient damage, a narrative of the storm's passage.

6. Form Prescribed. Units use PACAF Form 413, **Tropical Cyclone Satellite Position/Intensity Log**, to record tropical cyclone satellite-derived position and intensity estimates prior to transmission via long-line dissemination as prescribed in [Attachment 3](#).

GARRY R. TREXLER, Maj Gen, USAF
Director of Air and Space Operations

Attachment 1**GLOSSARY OF REFERENCES, ABBREVIATIONS AND ACRONYMS*****References***

USCINCPAC Instruction 3140.1x, *Tropical Cyclone Operations Manual*

NOAA Technical Report NESDIS 11, *Tropical Cyclone Intensity Analysis Using Satellite Data*

AFMAN 15-129, *Aerospace Weather Operations – Processes and Procedures*

AFMAN 37-139, *Records Disposition Schedule*

AFI 37-138, *Records Disposition—Procedures and Responsibilities*

Federal Meteorological Handbook Number 11 (FMH-11)

FCM-P12-YEAR *National Hurricane Operations Plan*

1 WW/TN-80/001, *Prediction of Typhoon induced Peak Winds at Four Pacific Stations*

JTWC/SATOPS/TN-97/001, *Updating Tropical Cyclone Satellite-Derived Position Code Number Criteria*

JTWC/SATOPS/TN-97/002, *Intensity Estimation of Tropical Cyclones during Extra-tropical Transition*

JTWC/SATOPS/TN-97/003, *Tropical Cyclone Positioning Using Microwave Imagery*

Abbreviations and Acronyms

AFWA—Air Force Weather Agency

AJTWC—Alternate Joint Typhoon Warning Center

AOR—Area of Responsibility

AOS—Air Operations Squadron

ATCR—Annual Tropical Cyclone Report

CAT—Crisis Action Team

CG—Commanding General

COR—Condition of Readiness

CPA—Closest Point of Approach

CPHC—Central Pacific Hurricane Center

DMSP—Defense Meteorological Satellite Program

FCJ—Field Command Johnston Atoll

FNMOC—Fleet Numerical Meteorology and Oceanography Center

GMS—(Japanese) Geostationary Meteorological Satellite

JTWC—Joint Typhoon Warning Center

MANOP—Manual of Operations

METSAT—Meteorological Satellite

MSC—Meteorological Satellite Coordinator

MSS—Meteorological Satellite Specialist

NHC—National Hurricane Center

NHOP—National Hurricane Operations Plan

NOAA—National Oceanic and Atmospheric Administration

NPMOC—Naval Pacific Meteorology and Oceanography Center

OPR—Office of Primary Responsibility

OPUP—Open-System Principal User Processor

OWS—Operational Weather Squadron

PUP—Principle User Processor

QC—Quality Control

SATOPS—Satellite Operations

SSM/I—Special Sensor Microwave Imager

SWO—Staff Weather Officer

TAF—Terminal Aerodrome Forecast

TCFA—Tropical Cyclone Formation Alert

TCRN—Tropical Cyclone Reconnaissance Network

TDO—Typhoon Duty Officer

TRMM—Tropical Rainfall Measuring Mission

TWR—Tactical Weather Radar

USPACOM—US Pacific Command

Attachment 2**PACIFIC TROPICAL CYCLONE RECONNAISSANCE NETWORK**

(KEY ADDRESS AND TELEPHONE NUMBERS)

(All numbers DSN unless otherwise indicated.)**A2.1. PEARL HARBOR, HAWAII****A2.1.1. 17 OWS/WXJ**

Telephone: 471-3533 (primary) Satellite Operations (SATOPS)
Comm 474-3946 (alternate) METSAT Coordinator
Comm 474-3946 NCOIC SATOPS
474-8905 (FAX)

Message: NAVPACMETOCCEN HI//SATOPS//

Mail: 17 OWS/WXJ
NAVPACMETOCCEN/JTWC
425 Luapele Rd
Pearl Harbor HI, 96860-3103

A2.1.2. JTWC

Telephone: 474-2320 (primary) Typhoon Duty Officer
474-4834 (alternate) Typhoon Duty Assistant
474-5301 Director, JTWC

Message: NAVPACMETOCCEN HI//41C/JTWC//

Mail: U.S. Naval Pacific Meteorology and Oceanography Center/
Joint Typhoon Warning Center
425 Luapele Rd
Pearl Harbor HI, 96860-3103

A2.2. YONGSAN AIN, KOREA**A2.2.1. 607 WS/DOF**

| | | |
|------------|----------------------|--------------------------|
| Telephone: | 725-6155 (primary) | METSAT Coordinator |
| | 725-6156 (alternate) | METSAT Coordinator |
| | 725-7820 (alternate) | (FAX) METSAT Coordinator |

Message: 607 WS SEOUL KOR//DOF//

Mail: HQ 607 WS/DOF
Unit # 15173
APO AP 96205-0108

A2.2.2. 607 WS/DO

| | | |
|------------|----------------------|-------------------------------|
| Telephone: | 725-6509 (primary) | 607 WS Director of Operations |
| | 725-3516 (alternate) | 607 WS Director of Operations |
| | 725-6155 (primary) | USFK-TFU Forecaster |
| | 725-6156 (alternate) | USFK-TFU Forecaster |

Message: 607WS SEOUL KOR//DO//

Mail: 607 WS/DO
Unit # 15173
APO AP 96205-0108

A2.3. 18 OSS/OSW, KADENA AB, JA

| | | |
|------------|----------------------|---------------------|
| Telephone: | 634-3140 (alternate) | Duty Forecaster-BWS |
|------------|----------------------|---------------------|

Message: 18OSS KADENA AB JA//OSW//

Mail: 18 OSS/OSW
Unit 5177
APO AP 96368-5177

A2.4. 20 OWS, YOKOTA AB, JA

Telephone: 225-9401 Operations Floor
225-8744 (FAX)

Message: 20OWS YOKOTA JA//CC

Mail: 20 OWS/DO
Unit 5070
APO AP 96328-5070

A2.5. HICKAM AFB, HAWAII

A2.5.1. HQ PA CAF/DOW

Telephone: 449-6174 (DOW)
448-1533 (DOWO)
448-8962 (FAX)

Message: HQ PACAF HICKAM AFB HI//DOW//

Mail: HQ PACAF/DOW
25 E St STE I232
Hickam AFB HI 96853-5426

A2.5.2. 17 OWS

Telephone: 449-8335
449-8336 (Secure FAX)

Message: 17OWS HICKAM AFB HI//CC//

Mail: 17 OWS
25 E St Suite M244

Hickam AFB, HI 96853

A2.6. USARPAC SWO, FT SHAFTER, HAWAII

Telephone: 438-6091

Message: CDR USARPAC FT SHAFTER HI//OPIN//

Mail: Commander
U.S. Army Pacific
Attn: OPIN-OPW (SWO)
Ft. Shafter HI 96858-5100

A2.7. 36 OSS/OSW, ANDERSEN AFB, GUAM

Telephone: 366-1408 (Primary)
366-5230 (Forecaster)
366-3151 (Fax)

Message: 36OSS ANDERSEN AFB GU//OSW//

Mail: 36 OSS/OSW
Unit 14035
APO AP 96543-4035

A2.8. AFWA/XOGM, OFFUTT AFB, NEBRASKA

Telephone: 271-7264 (primary)
271-2235 (Ops Officer/Chief Forecaster)
271-2821 (AFWA MSC)
271-2586 (operations center team chief)

Message: AFWA OFFUTT AFB NE//XOGM// (tropical work center)

Mail: HQ AFWA/XOGM
106 Peacekeeper Drive STE 2N3
Offutt AFB NE 68113-4039

A2.9. ALTERNATE JTWC (AJTWC) MONTEREY, CALIFORNIA

Telephone: 878-4325

Mail: Fleet Numerical Meteorology and Oceanography Center
7 Grace Hopper Road, Stop 1
Monterey, CA 93943-5501

A2.10. CENTRAL PACIFIC HURRICANE CENTER

| | |
|-------------------------------|----------------------|
| Telephone: 973-5284 (primary) | Hurricane Forecaster |
| 973-5280 (alternate) | 24-h District Desk |
| 973-5285 | Satellite Analyst |

These are commercial numbers - call the Pearl Harbor Switch at DSN 430-0111 and ask for a patch to the commercial number.

Mail: NWSFO Honolulu
2525 Correa Road
Suite 250
Honolulu HI 96822-2219

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Attachment 3**PACAF FORM 413 COLUMN HEADING AND ENTRIES**

| COLUMN HEADING (In Sequence) | ENTRY |
|-------------------------------------|--|
| TROPICAL CYCLONE | Enter name and number of tropical cyclone. |
| OB | Sequential number of observations for the tropical cyclone. |
| MONTH | Month of observation encoded in two digits. |
| DATE/TIME | 6-digit Date Time Group (UTC). For polar orbiters, use the nodal crossing time. Compute the relevant nodal crossing time for descending orbits. |
| LAT (LaLaLaC) | Center position latitude to nearest tenth degree. C is the checksum. Circle N or S (North or South). |
| LON (LoLoLoLoC) | Center position longitude to nearest tenth degree. C is the checksum. Circle E or W (East or West). |
| PCN | Position Code Number. Enter odd numbers if gridding based on geography (circulation center is within 10 degrees of the gridded feature). Enter even numbers if gridding is ephemeris-based. |
| SBC WRAP OR SHEAR DISTANCE | Use the DT column corresponding to the amount of wrap on the Log10 spiral or the distance (NM) that the LLCC is sheared from/embedded into deep convection. |
| EYE | Enter either the VIS embedded distance or the EIR surrounding gray shade meeting the minimum width criteria. Enter the corresponding E# and the necessary Eye Adjustment Value from NOAA TR NESDIS 11. |
| CDO | Central Dense Overcast. Enter diameter (NM) of CDO. |

| | |
|-------------|---|
| EMB | Embedded Center. Enter the grayshade used and the distance (NM) from the center to the edge of that gray shade meeting the minimum distance criteria. |
| DATA-T COMP | Data-T computation. CF (central feature) + BF (banding feature) = DT. |
| CCC | Central Cold Cover. Check if CCC is observed. |
| TREND | Enter D (developed), S (steady) or W (weakened) followed by the rate of change. Use “+” for rapid rate of change, “-” for slow rate, or leave blank for a normal rate of change. Use the rules as outlined in NOAA TR NESDIS 11. |
| MET | Model Expected T#. Adjustment of the final intensity from 24hrs (18-30h) ago. MET is the T# based on the D,W, or S and the rate as noted in the previous column. |
| PT | Pattern T#. Based on the charts in NOAA TR NESDIS 11. Use the MET value derived from the previous column as a baseline and adjust if necessary. |
| DVORAK CODE | Intensity estimation code. T#/CI/Trend/Period. T# is the Final intensity number. CI = Current Intensity. Trend/Period is amount of Final T# change over a specified period (18-30 h). Example: T3.0/3.0/D1.0/24HRS. |
| STT | Short Term Trend. Used if systems change is < 18h. Also used to supplement the Trend encoded within the Dvorak Code. An example is when the Dvorak Code trend indicates no intensity change from 24 hours ago but the storm actually weakened (indicating the system has possibly peaked) within the last 12 hours. |
| SPACECRAFT | Enter the spacecraft number or name, the revolution number and the satellite sensor(s) used. |

| | |
|------------|--|
| FIX TYPE | The type of center encoded in the Lat/Lon columns. Enter LLCC (Low Level Circulation Center), ULCC (Upper Level Circulation Center), or CSC (Cloud System Center). |
| FIX CODE | Enter the appropriate fix code. |
| REMARKS | Enter PBO (position based on) followed by the primary method used to position the circulation center, EYE, SBC, CDO, ANMTN, etc. Include qualifying parameters when applicable (eye diameter/definition, outflow patterns, etc.) If an intensity estimation was done, enter DBO (Dvorak based on) DT, PT or MET. |
| SITE FIXES | Check the column corresponding to the appropriate site. Use the blank column for other sites not listed. |
| INITIALS | Initials of the satellite analyst. |

Attachment 4**ACTIVE RADAR SITES**

| <u>UNIT OF ASSIGNMENT</u> | <u>LOCATION</u> | <u>Responsible OWS</u> |
|----------------------------------|------------------------|-------------------------------|
| 36 OSS/OSW | Andersen AFB, Guam | 17 OWS |
| 17 OWS/WXJ | Hickam AFB, Hawaii | 17 OWS |
| 18 OSS/OSW | Kadena AB, Japan | 20 OWS |
| 8 OSS/OSW | Kunsan AB, Korea | 20 OWS |
| Det 2, 607 WS | Camp Humphreys, Korea | 20 OWS |

Attachment 5

SURFACE RADAR MESSAGE FORMAT (WEST OF 180°)

| | | |
|---|----------------------|---|
| A | BULLETIN HEADER | A. WOPA1 XXXX DTG (where XXXX is the reporting station's ICAO). |
| B | SITE IDENTIFICATION | B. Name of Radar Site Reporting. |
| C | TROPICAL CYCLONE ID | C. (<i>e.g.</i> , TY 30W (BOBBIE)). |
| D | DATE AND TIME OF FIX | D. Zulu time expressed as day, hour and minutes (<i>e.g.</i> , 300622Z). |
| E | LATITUDE OF FIX | E. Degrees and minutes of latitude (N or S) plus check sum of the digits (<i>e.g.</i> , 1410N/6). |
| F | LONGITUDE OF FIX | F. Degrees and minutes of longitude (E or W) plus check sum (<i>e.g.</i> , 14510E/1). |
| G | FIX ACCURACY | G. Fix accuracy of EYE or CENTER and noted as follows: good, fair, poor for accuracy within 5, 15, 25 nm or greater respectively; <i>e.g.</i> , EYE/FAIR, CENTER/POOR. Note: if CENTER is outside radar range, state as CENTER/EXTRAPOLATED. |
| H | EYE SHAPE/SIZE | H. Eye shape/size as follows: If circular, report diameter (nm) and describe wall cloud as percent complete and average width; <i>e.g.</i> , CIRC/OPEN SW/80 PCT CLOSED/D/20. If eye is elliptical, report major and minor axes (NM); <i>e.g.</i> , ELIP AXIS 030/010. If concentric, report both inner and outer diameters; <i>e.g.</i> , CONC 4/20. If no eye is present or observed, enter N/A. |
| I | PAST MOVEMENT | I. Past movement = tddff: t = time interval for average (1 = 15 min, 2 = 30 min, 3,4,5,6, = 1,2,3,6 hours; dd = direction of movement from in tens of degrees; ff = speed of movement (knots); <i>e.g.</i> , 32812 (reads as the past 1-hour movement from 280 at 12 knots). If past movement is not available, enter N/A. |

J VELOCITY COUPLET

J. Velocity couplet defines the circulation center. If YES, use a velocity cross section to determine inbound and outbound low-level radial velocity maxima noting their speed and latitude (thousands of feet); *e.g.*, YES/INBND 70/5, OUTBND 65/7 (reads as inbound radial velocity maximum is 70 knots at 5000 feet, and outbound is 65 knots at 7000 feet). If a couplet is not present, enter NO, or if no WSR-88D is available, enter N/A.

K REMARKSK.

Remarks to include any comments that amplify or clarify the radar fix; *e.g.*, BOTH VELOCITY MAX OCCUR IN WALL CLOUD, INBND MAX AT LOWEST LVL OF X-SECTION.

SAMPLE REPORT

A. WOPA1 PGUA 300630Z

B. PGUA

C. TY 30W (BOBBIE)

D. 300622Z

E. 1410N/6

F. 14510E/1

G. EYE/FAIR

H. CIRC/OPEN SW/80 PCT CLOSED/D20

I. 32812

J. YES/INBND 70/5, OUTBND 65/7

K. BOTH VEL MAX OCCUR IN WALL CLOUD. INBND MAX AT LOWEST LVL OF X-SECT.

Attachment 6**SAMPLE TPXX BULLETIN FORMAT**

The following are examples of the TPXX bulletin. Only the first contains the 35kt radius wind section.

TPPN10 KGWC 051030

A. TYPHOON 01W (DAMREY)

B. 05/0933Z (49)

C. 20.3N/5

D. 122.9E/4

E. ONE/DMSP/THREE

F. T4.5/5.0/W0.5 24HRS -05/0532Z

G. WX4547/21658/ALS-TS-EIR-MI/D

32S/ PBO AN EYE ON 85H DATA AND SUPPORTED BY AN EMBEDDED LLCC
FROM OLS IMAGES.

H. CENTER WAS 0.7 DEGREES EAST OF NADIR.

I. GALE WIND RADIUS ANAL: BOUNDARY COMPASS POINTS

| | DRCTN | DSTC-NM | LAT | LONG |
|----|--------------|----------------|------------|-------------|
| 1. | N | 135 | 22.6N | 122.9E |
| 2. | NE | 155 | 21.8N | 125.2E |
| 3. | E | 125 | 20.3N | 125.2E |
| 4. | SE | 105 | 19.1N | 124.3E |
| 5. | S | 105 | 18.5N | 122.9E |
| 6. | SW | 115 | 18.8N | 121.7E |
| 7. | W | 110 | 20.3N | 121.0E |
| 8. | NW | 100 | 21.6N | 121.7E |

SMITH

TPPN10 PGTW 050632

A. TYPHOON 01W (DAMREY)

B. 05/0530Z

C. 19.7N/7

D. 123.6E/2

E. ONE/SATELLITE

F. T5.0/6.0/W0.5/24HRS STT: W1.0/06HRS (05/0530Z)

G. IR/EIR/VISLLCC

03A/PBO 6NM ROUND CLD FILLED EYE/ANMTN. SYSTM APPEARS TO BE WEAKINING. 24HR OLD IMAGERY SHOWS SIG WEAKINING TREND. OUTFLOW REMAINS GOOD AND SYSTM IS STILL WELL WRAPPED. EYE EMBDD 30NM INTO CNVCTN IN VIS IMAGERY AND LG EYE EMBDD INTO MG ON EIR. ALSO ADDED 1.0 BANDING FEATURE. DBO DT. PT AND MET AGREE.
SMITH

Attachment 7

WSR-88D OPERATIONS PLAN FOR TROPICAL CYCLONE EVENTS**(Extracted directly from the NHOP, May 99)**

The following procedures are used to modify WSR-88D operations in support of the tropical cyclone warning system:

At the Unit Control Position (UCP):

1. Operational mode—precipitation mode. Either **VCP 11** (14 elevations in 5 minutes) **or VCP 21** (9 elevations in 6 minutes). VCP 21 will cause less wear on antenna gearing, and offers reduced potential for loadshedding. For convection within 80 nm of the radar, VCP 11 offers denser vertical resolution above tilt 5 and is thus preferred for close-in cases and overpasses.

2. Velocity data levels (display levels) for the 8-data level products should be set to display hurricane-force winds. Note that default settings, which display a maximum of 64 kt, will be exceeded by even a minimal category one hurricane.

UCP commands: **SE, WXMAN1, VE** (enter appropriate menu)

| | | |
|------|-------------|--|
| then | D, 5 | <--display Table 5 first |
| then | M | (modify Table 5) suggested values are -100, -80 |
| then | E | (save edits) |
| then | D, 7 | <-- now display Table 7 |
| | M | (modify Table 7) suggested values are -135, -115 |
| then | E | (save edits) |

This modifies the 8-level products **ONLY**. The routine 16-level products are not affected. By entering the negative values above, corresponding positive values are automatically supplied. Table 5 will be used if the velocity increment is 1 kt (0.97 kt or 0.5 m/s) while Table 7 will be used if the velocity increment is increased to 2 kt (1.94 kt or 1 m/s). See paragraph 3 below. *Note: These are good initial settings for pre-event preparedness. As the hurricane comes into radar range, examine the velocities in the eyewall. Settings (as time allows) may be adjusted by 5 or 10 kt increments to produce a clean maximum (a 'bulls-eye') in the area of the velocity maximum. This velocity maximum is usually found on the right side of the eyewall (right side defined as standing behind the hurricane and looking forward along the direction of motion).*

3. If velocities are expected to exceed 124 kt, increase the velocity increment from 1 to 2 kt.

UCP commands: **RD, PR** (turn off auto pulse repetition frequency (PRF))
V (display current VCP)
V, 1.94 (switch velocity measurement increment (VMI) of current VCP)
E (save edits)
RD, DO, 0 (download modified VCP)
RD, PR (turn on auto PRF)

Note: If the velocity increment is 1 kt, Table 5 above applies; if the velocity increment is 2 kt, Table 7 above applies.

4. Allow non-associated Principal User Processors (NAPUP) (e.g. TPC/NHC) access to:

- a. 8-data level Velocity product (product #24).
- b. 0.54 nm Composite Reflectivity product (product #37).

These may be added to the Generation and Distribution Control list, Adaptation list 'A,' with a 'Y' in the NAPUP column. (Note: SRM, product #56, should already appear with a 'Y' for NAPUP.

UCP commands: **AD, WXMAN1, G, A**

then **M, 9** (modify line 9)

| | | | | | |
|-------|-----|-----|-----|-----|-----------|
| | | AUT | AUT | STO | NA |
| SLICE | GEN | ARC | STO | TIM | PUP |
| -2.0 | 1 | 0 | 1 | 60 | Y (con't) |

then **M, 22** (modify line 22)

| | | | | | |
|-------|-----|-----|-----|-----|-----|
| | | AUT | AUT | STO | NA |
| SLICE | GEN | ARC | STO | TIM | PUP |
| | 1 | 0 | 1 | 60 | Y |

then **E** (save edits)

G, R, A (replace current list with copy of changes)

G, E (save edits)

5. Make certain that Archive II is active.

6. If range-folding is obscuring velocities beyond about 70-80 nm, shown in extreme cases as a solid purple band surrounding the ‘good’ velocities, auto-PRF is not working effectively. Consider turning auto PRF **off**. Auto PRF uses only the 4 highest PRFs (5 through 8). To alleviate the purple band problem and extend the range of usable velocities, set PRF to PRF #4.

| | | |
|----------------------|------------------|------------------------------|
| UCP commands: | RD, PR | (turn off auto PRF) |
| | F1 | (return to main menu) |
| | V | (enter VCP menu) |
| | S, 94 | (set Rmax to 94 nm) |
| | E | (save edits) |
| then | F1 | (return to main menu) |
| | RD, DO, 0 | (down load the modified VCP) |
| To return to normal: | RD, PR | (turn auto PRF back on) |

7. Applications terminal, associated PUPs (APUP):

a. Suggested minimum routine product set (RPS) lists follow these instructions. Sites may wish to add Mesocyclone (M), Tornadic Vortex Signature (TVS), Storm Tracking (STI), and Echo Tops (ET) to the list. Storm Relative Velocity products (SRM, SRR) should be generated as One-Time Requests, with storm motion determined by the forecaster. The system software may not be able to produce a useful motion due to the rotation of the tropical cyclone. One-Hour Precip (looped) can also be useful in finding the tropical cyclone center in poorly defined cases.

b. Initiate a local product archive (Archive IV). This will copy the PUP database onto the optical disk for later assessment. This record has proven to be extremely useful even if Archive II is also running and can become crucial if Archive II fails.

*Most important here, for both APUPs and NAPUPs, is the **8-data level velocity product**, and, in the event of velocities exceeding 124 knots, changing the **velocity increment from 1 to 2 knots**.*

The advantage of using the 8-level velocity product is that the location of strong hurricane force winds can be displayed, while leaving the standard 16-level velocity product (-64 kt to +64 kt) for display of surrounding areas. The data resolution (i.e., “width” of the display levels) is maintained to aid identification of mesocyclones which may occur in rainbands.

Note that the key 8-level velocity product and the 0.54 nm composite reflectivity product are not available to non-associated users (e.g. TPC) by default, although some stations may already have granted access. These products can be made available to NAPUPs by inserting them into the Generation and Distribution Control list. Ideally, this amendment to the distribution list would be done in anticipation of an event, so that everything is ready to go should a hurricane approach. Again, local Unit Radar Coordinator approval

should be sought as necessary—in advance—so that the change can be made operationally as the need arises.

Additional note: For improved WSR-88D algorithm performance during tropical cyclone events, the Threshold Pattern Vector (TPV) adaptable parameter for the Mesocyclone algorithm should be reduced to improve detection of small diameter features. From the main menu:

| | | |
|---------------|-------------------------------|--|
| UCP commands: | AD, *****, M, *****, M | (display the mesoscale adaptable parameter menu) |
| change | TPV | (page forward to page 2) to 6 |
| then | E | (save edits) |

The default Z-R relationship does not perform well in tropical cyclones. Change the default Z-R (300R 1.4) to the tropical Z-R, (250R 1.2) to provide better precipitation estimates.

From the main menu:

| | | |
|---------------|---------------------------------|--------------------------|
| UCP commands: | AD,*****, M, *****, Z | (display Z-R parameters) |
| then | change CZM to 250 | |
| and | change CZP to 1.2 | |
| then | E | (save edits) |

Table A7.1. Suggested Minimum WSR-88D RPS Lists for Tropical Cyclones.

| | | | |
|--|------------------------|------------------------|--------------------|
| Tropical cyclone range > 124 nm | | | |
| <u>Product</u> | <u>Elevation angle</u> | <u>Data resolution</u> | <u>Data levels</u> |
| Base Reflectivity | 0.5 b | 1.1 nm | 16 |
| | 1.5 | 1.1 nm | 16 |
| | 0.5 | 0.54 nm | 16 |
| | 1.5 | 0.54 nm | 16 |
| | 2.4 | 0.54 nm | 16 |
| | 3.4 | 0.54 nm | 16 |
| Base velocity | 0.5 | 0.54 nm | 16 |
| | 1.5 | 0.54 nm | 16 |
| | 2.4 | 0.54 nm | 16 |
| | 0.5 | 0.54 nm | 16 |
| | | | 8 |
| Composite Reflectivity VIL, Storm Total Precip | | 0.54 nm | 16 |
| Tropical cyclone range 62 - 124 nm | | | |
| <u>Product</u> | <u>Elevation angle</u> | <u>Data resolution</u> | <u>Data levels</u> |
| Base Reflectivity | 0.5 | 1.1 nm | 16 |
| | 0.5 | 0.54 nm | 16 |
| | 1.5 | 0.54 nm | 16 |
| | 2.4 | 0.54 nm | 16 |
| | 3.4 | 0.54 nm | 16 |
| | 6.0 | 0.54 nm | 16 |
| Base velocity | 0.5 | 0.54 nm | 16 |
| | 1.5 | 0.54 nm | 16 |
| <u>Product</u> | <u>Elevation angle</u> | <u>Data resolution</u> | <u>Data levels</u> |
| Base velocity | 2.4 | 0.54 nm | 16 |
| (con't) | 3.4 | 0.54 nm | 16 |
| | 0.5 | 0.54 nm | 8 |
| Composite Reflectivity VIL, Storm Total Precip | | 0.54 nm | 16 |

| Tropical cyclone range > 32 - 62 nm | | | |
|---|------------------------|------------------------|--------------------|
| <u>Product</u> | <u>Elevation angle</u> | <u>Data resolution</u> | <u>Data levels</u> |
| Base Reflectivity | 0.5 | 1.1 nm | 16 |
| | 0.5 | 0.54 nm | 16 |
| | 1.5 | 0.54 nm | 16 |
| | 2.4 | 0.54 nm | 16 |
| | 4.3 | 0.54 nm | 16 |
| | 6.0 | 0.54 nm | 16 |
| Base velocity | 0.5 | 0.54/0.27 nm | 16 |
| | 1.5 | 0.54/0.27 nm | 16 |
| | 2.4 | 0.54 nm | 16 |
| | 4.3 | 0.54 nm | 16 |
| | 0.5 | 0.54 nm | 8 |
| Composite Reflectivity VIL, Storm Total Precip | | 0.54 nm | 16 |
| Tropical cyclone range 0 - 32 nm | | | |
| <u>Product</u> | <u>Elevation angle</u> | <u>Data resolution</u> | <u>Data levels</u> |
| Base Reflectivity | 0.5 | 1.1 nm | 16 |
| | 0.5 | 0.54 nm | 16 |
| | 1.5 | 0.54 nm | 16 |
| | 2.4 | 0.54 nm | 16 |
| | 3.4 | 0.54 nm | 16 |
| | 6.0 | 0.54 nm | 16 |
| | 9.9 | 0.54 nm | 16 |
| <u>Product</u> | <u>Elevation angle</u> | <u>Data resolution</u> | <u>Data levels</u> |
| Base velocity | 0.5 | 0.54/0.27/0.13 nm | 16 |
| | 1.5 | 0.54/0.27 nm | 16 |
| | 2.4 | 0.54 nm | 16 |
| | 0.5 | 0.54 nm | 8 |
| | 1.5 | 0.54 nm | 8 |
| Composite Reflectivity 0.54 nm 16 VIL, Storm Total Precip | | | |